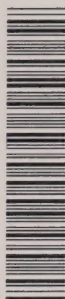


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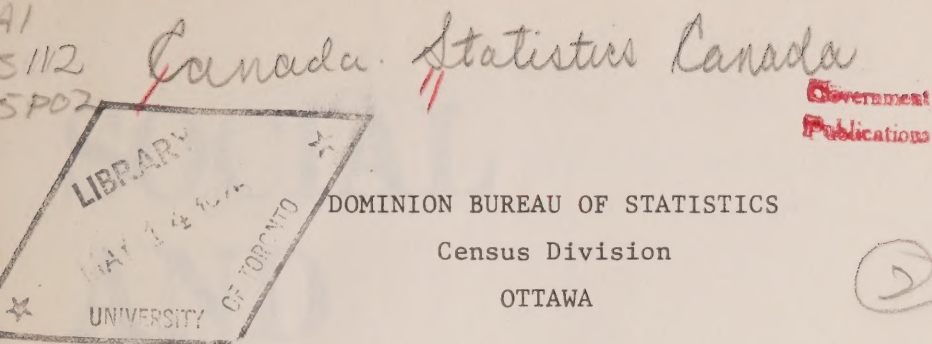
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(and see Supplement)

**INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH
UNIVERSITY OF THE WEST INDIES, JAMAICA**

Population Redistribution and Economic Development in Puerto Rico, 1950-1960^a

By

LEROY O. STONE

INTRODUCTION

It is now accepted generally that the technological advances which are typical of the economic development of a country tend to generate differences in economic change among regions of the country, and that these differences influence streams of inter-regional migration.¹ If, as this generalization suggests, national economic growth tends to involve inter-regional migration, then development planners should focus some attention on the demographic and economic implications of population redistribution.

Puerto Rico provides a rare opportunity for studies of the impact of migration among the regions of a country which is undergoing development. Rapid economic growth has been taking place in Puerto Rico since the 1940's,² and there exists a large quantity of good data which can be used in studying certain aspects of the development of this island. This paper offers a preliminary analysis of some of the aspects of Puerto Rican economic growth, using data contained in the reports of the 1950 and 1960 Censuses of the United States.

Simon Kuznets writes that "the relation between population redistribution and economic development is an important and indispensable link in the mechanism of modern economic growth".³ Several well known hypotheses support this statement by Kuznets. Basic among them is the proposition that regional gains in population redistribution through migration are highly and positively correlated with regional economic development. This hypothesis is supported by the Puerto Rican data for the 1950-1960 decade, as the subsequent analysis will show. This paper will also investigate the impact of population redistribution on differences between the rapidly developing and the lagging regions concerning changes in the age-sex composition of population and crude labour force participation rates.⁴

^aThis paper is based on research done under a Population Council Fellowship for the writer's doctoral dissertation at the University of Pennsylvania Population Studies Center. The writer is solely responsible for errors and opinions in this article.

¹See Dorothy Swaine Thomas, "Introduction," in Everett S. Lee, *et al.*, *Population Redistribution and Economic Growth, United States: 1870-1950*, Volume I. Philadelphia: The American Philosophical Society, 1957.

²See A. J. Jaffe, *People, Jobs and Economic Development*, Glencoe: The Free Press of Glencoe, 1959.

³See "Introduction," in Hope T. Eldridge and Dorothy Swaine Thomas, *Population Redistribution and Economic Growth, United States: 1870-1950*, Volume III, Philadelphia: The American Philosophical Society, 1964, p. xxii.

⁴The "crude labour force participation rate" is defined as the proportion in the labour force among those aged 14 and over. See the Appendix for the definition of "labour force".

EVALUATION OF THE HYPOTHESIS

This section shows that the Puerto Rican case supports the general hypothesis that a region's gain of population through net migration is positively and highly correlated with its economic development. For the purpose of this demonstration, nine regions of Puerto Rico are defined for use as the units of observation, and we examine the correlations between an index of economic development and rates of net intercensal migration.

The regions. Puerto Rico is 3,423 square miles in land area. This territory is subdivided into 76 administrative units, which are called "municipalities". The municipalities range in land area from five square miles to 126 square miles. The nine groups of contiguous municipalities which form the defined regions of Puerto Rico range in size from the 76 square miles of Mayaguez Standard Metropolitan Statistical Area (SMSA) to the 727 square miles of the Eastern Coastal Area. In 1960 their populations ranged from 84,000 (Mayaguez SMSA) to 648,000 (San Juan Area).

The nine regions may be classified into three groups. The first consists of three predominantly industrial areas. The second consists of four areas which specialized mainly in sugar production in 1950, the initial date of the period under study. The third group is comprised of two areas which specialized primarily in coffee and tobacco growing, respectively. San Juan Area, Ponce SMSA, and Mayaguez SMSA are the three predominantly industrial areas. The San Juan Area contains San Juan SMSA plus two contiguous municipalities.⁵ The Northern Coastal Area, The Eastern Coastal Area, the North-Western Coastal Area, and the South-Western Coastal Area are the four regions which have tended to specialize in sugar production. Each of these four areas extends from the coastline to the foothills of the mountain range which occupies most of the interior of the island. A large portion of this mountain range lies within the boundaries of the Eastern Highlands Area and the Western Highlands Area. In 1950 the former region specialized mainly in tobacco farming, while coffee growing was prominent in the latter.

The indicators. In this study the change in the proportion of the employed labour force in non-agricultural activity is used as the indicator of economic development over the 1950-1960 decade. Estimates of growth in regional income would be useful in this connection; but they are not available.

The shift of the working force out of agriculture is generally considered to be one of the principal indicators of economic development. The industrialization of an economy which this shift reflects involves major structural changes as well as income growth. These economic structural changes, such as the decline of handicrafts and the growth of factory work, tend to have far-reaching ramifications in the social structure of the developing country. This matrix of social and economic changes is thought to be reflected in

⁵Large portions of these two municipalities, Carolina and Trujillo Alto, are included by the Puerto Rico Planning Board in its "San Juan Metropolitan Region". See Eduardo Baranano, *Plan Regional del Area Metropolitana de San Juan*, San Juan, 1956, Map IV.

the shift of the working force out of agricultural activity.⁶

Change may be measured in different ways. The simplest of the possibilities is $p_{60} - p_{50}$, the difference between the 1960 and 1950 values of a proportion p . In this case p is the proportion of the employed labour force in non-agricultural activity. Because of the large inter-regional variation in the 1950 values of this proportion (see Table 1), and of the limited range of a proportion, it is necessary to use a transformation of $p_{60} - p_{50}$. If $p_{60} > p_{50}$, the measure of change is $(p_{60} - p_{50})/(1 - p_{50})$. If $p_{60} \leq p_{50}$, the measure is $(p_{60} - p_{50})/p_{50}$, which is the usual percentage change. Thus, given the direction of the change, $p_{60} - p_{50}$ is divided by the maximum change which could have occurred. This measure may be called the "relative change". Hence the indicator of development over the 1950-1960 decade is the relative change in the proportion of the employed labour force in non-agricultural activity.

The regional redistribution of population through migration is measured by the net intercensal migration rate, the two censuses being the 1950 and 1960 Censuses of Population. The rate for a given region is defined as the estimated net intercensal migration to the region divided by its 1950 population. The residual estimate of net intercensal migration,⁷ which is used here, measures directly the redistribution of population which is due to migration.⁸ The writer has prepared estimates of net intercensal migration by age and sex for each of the nine defined regions of Puerto Rico.⁹ The net migration rates, which are based on these estimates, are correlated with the indicator of economic development in order to evaluate the hypothesis which has been stated at the beginning of this section.

According to Table 3, the Puerto Rican data support the hypothesis that regional economic development is positively correlated with regional redistribution of population through migration. The 0.61 coefficient of rank correlation between the net migration rate for persons alive at the time of the 1950 Census and the relative change in the proportion of the employed labour force in non-agricultural activity is not especially high. It should be noted, however, that the migration rate does not reflect the population redistribution of persons born during the 1950-1960 decade. The data in Table 3 suggest that the positive correlation between regional development and popu-

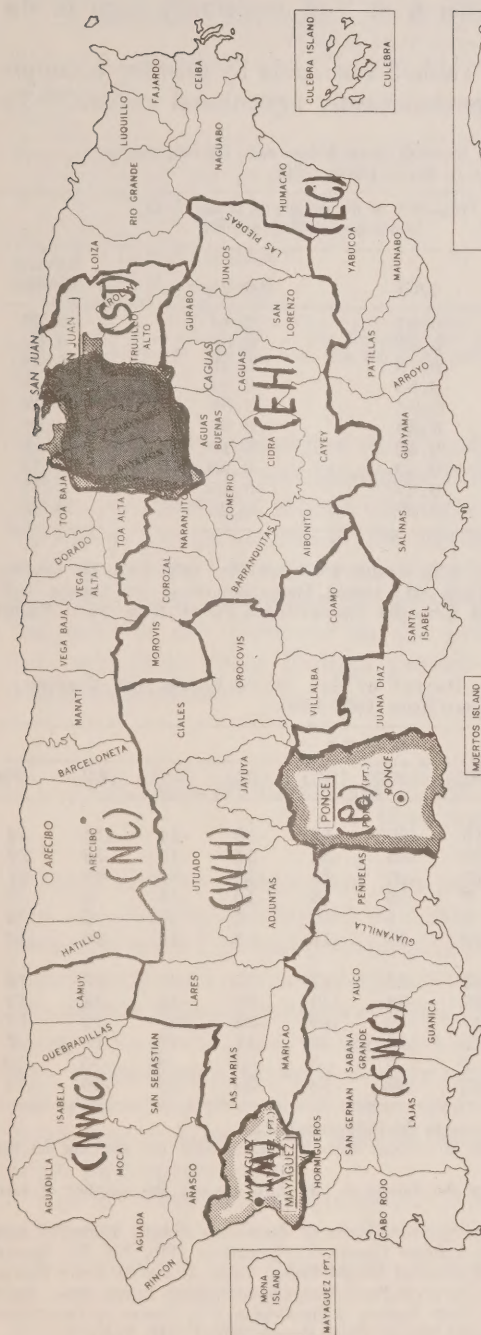
⁶See Kingsley Davis and Hilda Hertz Golden, "Urbanization and the Development of Pre-Industrial Areas," in Paul K. Hatt and Albert J. Reiss, Jr., (eds.), *Cities and Society*, New York: The Free Press of Glencoe, Inc., 1957, pp. 120-140; United Nations, Department of Economic and Social Affairs, *Demographic Aspects of Manpower, Report 1*, New York: United Nations, 1962, p. 6; Andrew Collver and Eleanor Langlois, "The Female Labor Force in Metropolitan Areas: An International Comparison," *Economic Development and Cultural Change*, Vol. X, No. 4 (July, 1962), pp. 367-385.

⁷See the Appendix for the definition of the estimate.

⁸The residual estimate of net intercensal migration is the difference between the surviving immigrants to the region in question and the surviving out-migrants, which is the redistribution of population due to migration. See Jacob S. Siegel and C. Horace Hamilton, "Some Considerations in the Use of the Residual Method of Estimating Net Migration", *Journal of the American Statistical Association*, Vol. 47, No. 259 (September, 1952), pp. 475-500.

⁹Appendix F of the writer's doctoral dissertation contains a full statement of the basis of these estimates. See Leroy O. Stone, "Some Demographic Aspects of Economic Changes in Sub-Regions of Puerto Rico, 1950-1960", unpublished doctoral dissertation, Department of Sociology, University of Pennsylvania, 1964.

REGIONS OF PUERTO RICO



LEGEND

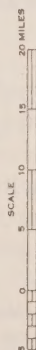
- Places of 100,000 or more
- Places of 50,000 to 100,000
- Places of 25,000 to 50,000

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Standard Metropolitan Statistical Areas—

- With 250,000 or more
- With 100,000 to 250,000
- With less than 100,000



(NW), North-Western Coastal Area
(NC), Northern Coastal Area
(SJ), San Juan Area
(SW), Eastern Coastal Area

LEYENDA

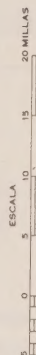
- Lugares de 100,000 o más
- Lugares de 50,000 a 100,000
- Lugares de 25,000 a 50,000

WASHINGTON



Areas Estadísticas Metropolitanas—

- Con 250,000 o más
- Con 100,000 a 250,000
- Con menos de 100,000



(EH), Eastern Highlands Area
(Po), Ponce
(SW), South-Western Coastal Area
(M), Mayaguez
(WH), Western Highlands Area

lation redistribution through migration is at least moderately high in the Puerto Rican case.

A further check of the findings in Table 3 was made by drawing a sample of 35 municipalities from the six predominantly agricultural regions.¹⁰ To

TABLE 1. REGIONAL SCORES ON THE INDICATOR OF ECONOMIC DEVELOPMENT:
REGIONS OF PUERTO RICO, 1950-1960.

Areas	Proportion of the employed labour force in non-agricultural activity			Relative Change
	1960	1950	Difference	
(P) ^a	0.75	0.61	0.14	0.36
(SJ)	0.97	0.89	0.08	0.62
(Po)	0.89	0.79	0.10	0.45
(M)	0.88	0.84	0.04	0.19
(SWC)	0.60	0.56	0.04	0.05
(NWC)	0.53	0.50	0.03	0.06
(NC)	0.66	0.50	0.16	0.29
(EC)	0.61	0.43	0.18	0.29
(WH)	0.46	0.37	0.09	0.13
(EH)	0.67	0.47	0.20	0.35

^a "(P)" refers to Puerto Rico.

Sources: United States Bureau of the Census, *U.S. Census of Population: 1950 Vol. II: Characteristics of Population*, Part 53: Puerto Rico, Table 40. United States Bureau of the Census, *U.S. Census of Population: 1960, General Social and Economic Characteristics, Puerto Rico*, Final Report PC(1) - 53c, Table 70.

TABLE 2. NET INTERCENSAL MIGRATION RATES* BY SEX BY SELECTED AGE GROUPS:
REGIONS OF PUERTO RICO, 1950-1960.

Age in 1950	Areas									
	(SJ)	(Po)	(M)	(SWC)	(NWC)	(NC)	(EC)	(WH)	(EH)	(P) ^a
<i>Males</i>										
0-9	1 ^b	-10	-17	-18	-20	-15	-18	-24	-16	-14
10-19	8	-18	-19	-39	-35	-32	-35	-46	-35	-27
20-34	-5	-12	-26	-27	-10	-23	-30	-34	-25	-21
35-64	2	-2	-11	-7	-18	-6	-10	-14	-6	-6
65 & over	0	-2	-3	-1	-1	0	0	-6	-1	-1
Total	1	-11	-18	-22	-23	-19	-23	-29	-20	-16
<i>Females</i>										
0-9	7	-8	-19	-23	-22	-17	-23	-27	-19	-15
10-19	4	-15	-24	-38	-33	-30	-38	-45	-34	-26
20-34	-5	-11	-22	-21	-19	-18	-22	-27	-19	-17
35-64	6	-6	-12	-12	-13	-9	-11	-17	-10	-7
65 & over	7	-2	-3	-2	-5	0	-3	-8	-3	-0
Total	3	-10	-19	-23	-22	-18	-23	-28	-20	-16

*Estimated number of net migrants per 100 persons in the 1950 population.

^a These figures are based on the enumeration of persons born in Puerto Rico but residing on the United States mainland.

^b In San Juan area it was necessary to adjust the figures to take into account the number of residents not born in Puerto Rico.

Sources: United States Bureau of the Census, *op. cit.* (*Census of Population 1950*). Tables 37 and 41. United States Bureau of the Census, *United States Census of Population: 1950, Vol IV: Special Reports*, Part 3, Chapter D: Puerto Ricans in Continental United States, Table 2. United States Bureau of the Census, *U.S. Census of Population: 1950, General Population Characteristics: Puerto Rico*, Final Report PC(1) - 53B, Tables 18 and 28. United States Bureau of the Census, *U.S. Census of Population: 1960, Subject Reports: Puerto Ricans in the United States*, Final Report PC(2) -1D, Table 1.

¹⁰The regions were treated as strata, and one half of the municipalities in each region were selected at random.

TABLE 3. COEFFICIENTS OF RANK CORRELATION (KENDALL'S *Tau*) BETWEEN THE INDICATOR OF ECONOMIC DEVELOPMENT AND SELECTED NET INTERCENSAL MIGRATION RATES: REGIONS OF PUERTO RICO, 1950-1960.

Migration rates	Relative change in the proportion of the employed labour force in non-agricultural activity
Net migration rate, population aged ten and over in 1960	0.61*
Net migration rate, population aged 10-19 in 1950	0.50*
Net migration rate, males aged 20-34 in 1950	0.39
Net migration rate, females aged 20-34 in 1950	0.50*

*An asterisk indicates that if the regional rank order differentials are independent then the coefficient is statistically significant at the 5% level, with a one-tailed test of the null hypothesis of no correlation.

Sources: Tables 1 and 2.

this sample were added the three predominantly industrial areas (San Juan Area, Ponce SMSA, and Mayaguez SMSA). Among these 38 units of observation, the coefficient of rank correlation (Kendall's *tau*) between the relative change in the proportion of the employed labour force in non-agricultural activity and the net intercensal migration rate for persons aged ten and over in 1960 is 0.42. According to the 95 per cent confidence interval estimate, the value of the coefficient for the entire set of municipalities lies between 0.17 and 0.61. These findings provide further support for the above-mentioned hypothesis.

REGIONAL DIFFERENTIALS IN THE CONSEQUENCES OF POPULATION REDISTRIBUTION

Since regional development and population redistribution through migration are positively correlated in Puerto Rico, what are the important differentials between the rapidly developing and the lagging regions in regard to the demographic and economic implications of population redistribution. A definitive answer to this question is not available; because, among other reasons, adequate data do not exist for intensive research on the implications of population redistribution through migration. However, the available data do permit some study of regional differentials in the impact of population redistribution on changes in the age-sex composition of population and in labour force participation rates.

Age-sex compositional changes. It is convenient to distinguish between the short-run and the long-run effects of net migration on changes in the age-sex composition of a population. In the short run, the impact of net migration consists mainly of the alteration of the rate of change in the size of the population aged 20-34. In the long run, there is also an impact on the birth rate which assumes increasing importance. By influencing the rates of change in the numbers of people in the peak ages of family formation and of fertility,

net migration can have an important long-run effect on the proportion of children in the population. We can only speculate about this long-run effect; because the existing data do not permit an identification of the separate contribution of migrants to the birth rate. If the lowest birth rates are observed initially in the regions which are gaining in the redistribution of the population in the peak ages of fertility, this redistribution should tend to generate a convergence of the regional birth rates.

In regard to the short-run effects of net migration on age-sex compositional changes, the data in Table 2 are helpful. Table 2 shows that the San Juan Area, the most rapidly developing of the regions, had the only net intercensal migration gains over the 1950-1960 decade. Even this area sustained a net migration loss among those aged 20-34 in 1950. The general uniformity of negative net intercensal migration rates among the other regions reflects a wave of net intercensal emigration from Puerto Rico to the United States mainland. An estimated 16 per cent of the 1950 native-born population of the island were residents of the mainland in 1960, as Table 2 shows. In spite of the confounding of the influences of the internal and external streams of migration, Table 2 indicates a general tendency for the more rapidly developing regions (San Juan Area, Ponce SMSA, Eastern Highlands Area, Northern Coastal Area, and Eastern Coastal Area) to show the highest (algebraically) net migration rates.

In regard to the influence of net intercensal migration on the sex composition by age, Table 2 shows that net migration to the two most rapidly developing areas (San Juan Area and Ponce SMSA) tended to be selective of females, rather than of males. The net migration from the lagging regions was more selective of males than of females. This pattern is explained by the predominance of males in the net emigration from the island.

In regard to the effects of net intercensal migration on the age composition, Table 2 shows that the net migration losses sustained by the lagging regions were concentrated among those aged 10-34 in 1950. In these regions the losses were particularly heavy among those aged 10-19 in 1950. Some 46 per cent of the 1950 male population aged 10-19 in the Western Highlands Area, a region which is known to have sustained major economic decline in this century, resided elsewhere in 1960. A similarly heavy rate of net out-migration is shown for the age group 20-34 in 1950. Such losses doubtless had a marked effect on the rate of change in the number of persons aged 20-44 in the population of the Western Highlands Area. In San Juan Area and Ponce SMSA, the two most rapidly developing regions, the observed net migration losses are not nearly as severe as those of the lagging regions. San Juan Area had net in-migration among those aged 10-19 in 1950. In general, the overall effect of the net intercensal migration was to redistribute the population of working age in favour of the rapidly growing regions.

Labour force participation rates. If the general result of the net intercensal migration was the redistribution of the population aged 20-44 in favour of

the rapidly developing regions, this redistribution may have influenced regional differentials in change of the crude labour force participation rate. The age specific labour force participation rates for males, in particular, are highest within the ages of 20 and 44, and the redistribution of the population aged 20-44 should have tended to increase the crude male labour force participation rate in the more rapidly growing regions. A depressing influence should have been exerted on the crude male labour force participation rate in the lagging regions. These expectations are confirmed by Table 4. Although the crude male labour force participation rate declined in all of the regions, the declines were heaviest in the lagging ones. An 0.89 coefficient of rank correlation is observed between the change in the crude male labour force participation rate and the net intercensal migration rate for males aged ten and over in 1960.

TABLE 4. CHANGES IN CRUDE LABOUR FORCE PARTICIPATION RATES: REGIONS OF PUERTO RICO, 1950-1960.

Areas	Male labour force participation rate			Female labour force participation rate		
	1960	1950	Difference	1960	1950	Difference
(P)	0.65	0.70	-0.05	0.20	0.21	-0.01
(SJ)	0.68	0.70	-0.02	0.27	0.25	0.02
(Po)	0.66	0.67	-0.01	0.20	0.20	0.00
(M)	0.63	0.68	-0.05	0.23	0.35	-0.12
(SWC)	0.65	0.70	-0.05	0.16	0.30	-0.14
(NWC)	0.66	0.73	-0.07	0.13	0.26	-0.13
(NC)	0.67	0.71	-0.04	0.20	0.15	0.05
(EC)	0.64	0.71	-0.07	0.16	0.14	0.02
(WH)	0.60	0.72	-0.12	0.10	0.16	-0.06
(EH)	0.63	0.70	-0.06	0.20	0.18	0.02

Sources: United States Bureau of the Census, *op. cit.* (*Census of Population: 1950*), Table 40. United States Bureau of the Census, *op. cit.* (*Census of Population: 1960*, PC(1) - 53C), Table 68.

The crude female labour force participation rate increased only in the more rapidly developing regions, according to Table 4. The writer has shown elsewhere¹¹ that this pattern of changes is explained largely by the specialization of the lagging regions in home needlework, a formerly important but recently declining activity. The more modern production sectors, in regard to the employment of females, are concentrated in San Juan Area and its adjoining regions. The net migration rates fail to account significantly for the observed pattern of changes in the female labour force participation rate.

CONCLUSION

We may conclude that in the Puerto Rican case there is support for the general claim that the economic development of a country tends to involve the redistribution of population among regions of the country. Through its influence on this redistribution, development has an impact on regional differentials in changes of the age-sex composition of population and of the male labour force participation rate.

¹¹ Leroy O. Stone, *op. cit.*

These demographic consequences of development will, in turn, have economic ramifications. The redistribution of the population in the peak ages of labour force participation affects regional differentials in the rate of growth of the consumer market. This redistribution also influences differences between regions in the rate of change of the dependency load. The exact nature of these consequences depends on such factors as regional differentials in educational facilities, regional variation in levels of underemployment and unemployment, the extent of income transfers between regions, the composition and volume of inter-regional trade, and the likelihood of structural changes in the economies of lagging regions. Much research remains to be undertaken in this area of interrelations between demographic, economic, and social changes among the regions of a developing country.

APPENDIX

1. *The estimate of net migration.* The estimates of net intercensal migration which are used in this paper were obtained by means of the census survival ratio technique. Let " $P_a(x,t)$ " refer to the population of place a which is aged x at time t . Let " $R(x)$ " be the proportion of $P_a(x,t)$ which survives ten years, that is up to time $t+10$. Then the survival ratio estimate of net intercensal migration is defined as $P_a(x+10, t+10) - R(x)P_a(x,t)$.

In the present application of this estimate $R(x)$ is based on census data. $R(x)$ is estimated by obtaining the number of Puerto Rican born persons aged $x+10$ in 1960 who were residing *either* on the island *or* on the United States mainland. This number is divided by the corresponding population aged x in 1950. This estimate of $R(x)$ assumes that a negligible proportion of Puerto Rican born persons resided in places other than the island or the United States mainland, an assumption which is generally accepted.

Census survival ratios are subject to the errors of enumeration and reporting which are typical of census data. However, this characteristic is, to some extent, fortunate; because it promotes the mutual cancellation of measurement errors in the net migration rate.

2. *Definition of the civilian labour force.* The labour force consists of the employed plus the unemployed. A civilian who is at least 14 years old is classified as employed, over a specified period, if (a) he is working for pay or profit, or (b) he does unpaid family work for at least 15 hours per week, or (c) he has a job although he is temporarily absent from work. A civilian who is at least 14 years old is classified as unemployed, over a specified period, if he is not at work, and (a) is looking for work, or (b) is not looking for work *because* he is either ill temporarily, or is expecting to return to a job from which he has been indefinitely laid off, or he believes no work is available. Persons less than 14 years of age are not classified as being in the labour force.¹²

¹²See United States Bureau of the Census, *op. cit.* (*Census of Population: 1950*), p. 53-IX. The census week is the period of reference for the enumeration of the labour force in the *Census of Population*.

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